VERIFICATION STATEMENT FOR TRANSLATION

I, Shigeo Ishijima, an attorney of ISHIJIMA·ABE & ASSOCIATES of TORANOMONKOUGYOU BUILDING 3RD FLOOR, 2-18, TORANOMON 1-CHOME, MINATO-KU, TOKYO 105-0001 JAPAN, do solemnly and sincerely declare that I am conversant with the Japanese and English languages and I have executed with the best of my ability this translation into English of Japanese Patent Application No. 2000-226445 attached hereto which was filed on July 27, 2000 in the name of

FLEXIBLE WIRING BOARDS AND PROCESSES FOR PRODUCING FLEXIBLE WIRING BOARD

and its amendment filed on September 5, 2000. I believe that the translations are true and correct.

Tokyo: August 19, 2005

Shigeo Ishijima

PATENT OFFICE JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of the following application as filed with this Office.

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Applicant(s):	Sony Chemicals Corp.

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【SUBMISSION】 Figure 1

【SUBMISSION】 Abstract 1

【REGISTERED NUMBER OF GENERAL POWER OF ATTORNEY】

9801419

【NEED OF PROOF】 Yes

[DOCUMENT] Specification

[TITLE OF INVENTION] FLEXIBLE WIRING BOARDS AND PROCESSES FOR PRODUCING FLEXIBLE WIRING BOARD

[SCOPE OF CLAIMS]

[Claim 1] A flexible wiring board having:

a first resin film;

a first wiring film the bottom face of which is embedded into said first resin film; and

a second wiring film the bottom face of which is in contact with the surface of said first resin film.

[Claim 2] The flexible wiring board as claimed in claim 1 wherein a surfaces of said first wiring film is flush with a surface of said second wiring film.

[Claim 3] The flexible wiring board as claimed in claim 1 or 2 wherein a second resin film is formed on the surfaces of said first and second wiring films.

[Claim 4] The flexible wiring board as claimed in claim 3 further comprising either in one or both of a first opening and a second opening are formed in said second resin film wherein said first wiring film is exposed at a bottom of said first opening, and said second wiring film is exposed at a bottom of said second opening.

[Claim 5] The flexible wiring board as claimed in claim 1 or 2 further comprising a third opening is formed in said first resin film, wherein said first wiring film is exposed at a bottom

of said third opening.

[Claim 6] The flexible wiring board as claimed in claim 4 or 5 wherein a metal bump is located in at least one of said first to third openings.

[Claim 7] A process for producing a flexible wiring board which comprises:

the step of etching a metal foil halfway in the thickness direction to form concavities of a predetermined pattern in said metal foil;

the step of forming a first resin film on the surface of said metal foil in the side where said concavities are formed;

the step of forming a resist layer, which is provided with openings at the parts corresponding to the concavities, on the back face of said metal foil; and

the step of etching the parts exposed at the bottom face of said opening so as to divide the first wiring film having the same thickness as the thickness of said metal foil and the second wiring film having the same thickness as the thickness of the part where said concavities are formed.

[Claim 8] The process for producing a flexible wiring board as claimed in claim 7 wherein a second resin film is formed on said first resin film in the side where said first and second wiring films are formed.

[Claim 9] The process for producing a flexible wiring board as claimed in claim 7 or 8 wherein an opening is formed

in the predetermined part of said first resin film where said first wiring film is disposed.

[Claim 10] The process for producing a flexible wiring board as claimed in claim 8 or 9 wherein openings are formed either in one or both of the part of said second resin film where said first wiring film is located and the part where said second wiring film is disposed.

[DETAIL DESCRIPTION OF THE INVENTION]

[0001]

[TECHNICAL FILED TO WHICH THE INVENTIN BELONGS]

This invention belongs to the technical filed of flexible wiring boards. More particularly, it relates to a technique of constructing flexible wiring boards having wiring films in which a high electric current appropriately flows.

[0002]

[PRIOR ART]

There have been frequently employed flexible wiring boards having wiring films patterned in desired.

In Fig. 9, the numerical symbol 110 stands for an example of flexible wiring boards of the conventional art.

[0003]

This flexible wiring board 110 has a first resin film 117, first and second wiring films 121 and 122 located on the first resin film 117, and a second resin film 125 formed on the first and second wiring films 121 and 122.

[0004]

Although the first and second wiring films 121 and 122 has the same thickness, the first wiring film 121 is wider than the second wiring film 122. Therefore, the sectional area of the first wiring film 121 is larger than the sectional area of the second wiring film 122.

[0005]

Since the first wiring film 121 having the larger sectional area has a smaller electrical resistance than the second wiring film 122, a higher current can flows through it.

With the recent tendency toward high-density flexible wiring boards, it is required to be high density wiring film. However, such wide first wiring film 121 as described above interferes the high density of wiring film.

[0006]

[PROBLEMS TO BE SOLVED BY THE INVENTION]

The present invention, which has been made to solve the troubles encountering in the conventional art as described above, aims at providing a technique of constructing flexible wiring boards having wiring films which show a small electrical resistance and yet have been finely patterned.

[0007]

[MEANS TO SOLVE THE PROBLEMS]

To solve the above-described problems, the present invention according to claim1 provides a flexible wiring board

having a first resin film, a first wiring film the bottom face of which is embedded into the first resin film, and a second wiring film the bottom face of which is adhered to the surface of the first resin film.

The present invention according to claim 2 further provides a flexible wiring board of claim 1 wherein the surface of the first wiring film is flush with the surface of said second wiring.

The present invention of claim 3 is a flexible wiring board according to claim 1 or 2 further provide a flexible wiring board wherein a second resin film is formed on the surfaces of the first and second wiring films.

The present invention of claim 4 further provides a flexible wiring board according to claim 3 wherein either in one or both a first and a second opening are formed in the second resin film, wherein said first wiring film is exposed at the bottom of said first opening and the second wiring film is exposed at the bottom of said second opening.

The present invention of claim 5 further provides a flexible wiring board according to claim 1 or 2 wherein a third opening is formed in the first resin film, wherein the first wiring film is exposed at the bottom of said third opening.

The present invention of claim 6 further provides a flexible wiring board according to claim 4 or 5 wherein a metal bump is located in at least one of the first to third openings.

The present invention of claim 7 further provides a process

for producing a flexible wiring board which comprises the step of etching a metal foil halfway in the thickness direction to form concavities of a predetermined pattern in the metal foil, the step of forming a first resin film on the surface of the metal foil in the side where the concavities are formed, the step of forming a resist layer, which is provided with openings at the parts corresponding to the concavities, on the back face of the metal foil, and the step of etching the parts exposed at the bottom face of said opening so as to divide the first wiring film having the same thickness as the thickness of the metal foil and the second wiring film having the same thickness as the thickness of the part where the concavities are formed.

The present invention of claim 8 further provides a process for producing a flexible wiring board according to claim 7, wherein a second resin film is formed on the first resin film in the side where the first and second wiring films are formed.

The present invention of claim 9 further provides a process for producing a flexible wiring board according to claim 7 or 8, wherein an opening is formed in the predetermined part of the first resin film where the first wiring film is located.

The present invention of claim 10 further provides a process for producing a flexible wiring board according to claim 8 or 9 wherein openings are formed either in one or both of the part of the second resin film where the first wiring film is located and the part where the second wiring film is disposed.

[0008]

The present invention has the constitution as described above. The flexible wiring board according to the present invention has the first and second wiring films separated from each other by a groove. The first wiring film has a thickness larger than the film thickness of the second wiring film. Since the section area of the first wiring film is larger because of the larger film thickness, the electrical resistance of the first wiring film can be lowered even in case where the first wiring film has the same width as the second wiring film.

[0009]

In the process for producing the flexible wiring board according to the present invention, concavities of a predetermined pattern are formed in a metal foil and then a resin solution is applied to the face having these concavities, thereby filling the concavities with the resin solution. Subsequently, the whole construct is dried and baked. Thus a first resin film having a flat surface can be formed.

[0010]

When the above-described metal foil is patterned and a resin solution is applied to the surface of each wiring films thus formed, grooves located among these wiring films are filled with the resin solution. After drying and baking, a second resin film having a flat surface can be formed.

[0011]

The surface of the first wiring film is flush with the surface of the second wiring film. When the above-described second resin film is formed on the first and second wiring films, the thickness of the second resin film on the first wiring film is almost the same as the thickness of the second resin film on the second wiring film. By forming openings in the second resin film by etching, therefore, the surfaces of the first and second wiring films can be exposed at the bottom faces of the openings almost at the same time as the etching proceeds.

[0012]

[MODE FOR CARRYING OUT THE INVENTION]

The invention will be illustrated by reference to the attached drawings.

Figs. 1(a) to (e), Figs. 2(f) to (j) and Figs. 3(k) to (m) show a production process of the flexible wiring board of the first example according to the present invention.

[0013]

As Fig. 1(a) shows, a protective film 13 is applied to a metal foil 11 (a copper foil of 32 μm in thickness is used herein). After forming a resist layer on the back face of the metal foil 11, the resist layer is exposed, developed and pattered.

[0014]

In Fig. 1(b), the numerical symbol 15 stands for the resist layer which has been patterned in the above step. A long and

narrow opening 16 is formed in this resist layer 15 by the patterning and the metal foil 11 is exposed at the bottom face of this opening 16.

[0015]

Next, the whole construct is immersed in a liquid etchant and thus the metal foil 11 exposed at the bottom face of the opening 16 is etched by 20 μm. Thus, a concavity 40 of 20 μm in depth, which has the same planar shape as the opening 16, is formed in the metal foil 11, as shown in Fig. 1(c).

As a result, a thick film part 11a protected with the resist layer 15 and a thin film part 11b, where the concavity 40 is located, are formed in the metal foil 11.

The thick film part 11a has the same thickness as the original thickness of the metal foil 11. The thin film part 11b has a thickness of 12 μm.

[0016]

Next, the resist layer 15 on the surface of the metal foil 11 and the protective film 13 on the back face of the metal foil 11 are peeled off (Fig. 1(d)) and a raw material solution containing a polyimide resin is applied to the surface of the metal foil 11 wherein the concavity 40 is formed until the thin film part 11b and the thick film part 11a are submerged. Thus the concavity 40 in the metal foil 11 is filled with this raw material solution. Then the construct in the above condition is dried and baked. As a result, a first resin film 17 made

of a polyimide film with a flat surface is formed as shown in Fig. 1(e).

[0017]

Next, a protective film 27 is applied to the flat surface of the first resin film 17 and a resist layer is formed on the face in the opposite side of the metal foil 11 to the side where the first resin film 17 has been formed. Subsequently, the resist layer is patterned by exposing and developing to thereby form a resist layer 18 having plural openings 19 on the thin film part 11b of the metal foil 11, as shown in Fig. 2(f). The thin film part 11b of the metal foil 11 is exposed at the bottom faces of the openings 19.

[0018]

These openings 19 have a long and narrow shape and the resist layer 18 is divided into plural parts by these openings 19. The numerical symbol 18a stands for the resist layer located on the surface of the thick film part 11a of the metal foil 11, while the numerical symbol 18b stands for the resist layer located on the surface of the thin film part 11b of the metal foil 11.

[0019]

Next, the whole construct is immersed in a liquid etchant and thus the metal foil 11 is etched in the parts exposed at the bottom faces of the openings 19. After etching the metal foil 11 by the thickness of the thin film part 11b, the resist layer 18 is peeled off.

As shown in Fig. 2(g), the groove 41 has the same planar shape as the opening 19 of the resist layer 18. The the metal foil 11 is divided into plural parts by these grooves 41. In the result, the first wiring film 21 is formed from the thick film part 11a and the second wiring film 22 is formed from the thin film part 11b.

[0020]

In this state, the bottom faces of the first wiring film 21 and the second wiring film 22 are fixed to the first resin film 17. The bottom face of the second wiring film 22 is located on the surface of the first resin film 17, while the bottom face of the first wiring film 21 is located more deeply than the bottom face of the second wiring film 22 and embedded into the first resin film 17. The surface of the first wiring film 21 is located at the same height as the surface of the second wiring film 22 and thus the surface of first wiring film 21 is flush with the surface of the second wiring film 22.

[0021]

Next, a raw material solution containing polyimide resin is applied to the surface of the first resin film 17 in the side where the first and second wiring films 21, 22 are formed until the first and second wiring films 21 and 22 are submerged. Grooves 41 are located between the first and second wiring film 21 and 22, and/or located between the second wiring films 22, and those grooves 41 are filled with the raw material soluiton.

Then the whole construct is dried and baked. As a result, a second resin film 25 made of a polyimide film having a flat surface is formed (Fig. 2(h)).

[0022]

Next, as shown in Fig.2 (i), a resist layer having circular openings 29a, 29b patterned in a predetermined position above the first and second wiring films 21 and 22 is formed. Subsequently, an alkali solution is sprayed onto the surface of the resist layer 28 so as to etch the second resin film 25 exposed at the bottom faces of the circular openings 29a and 29b.

[0023]

The thickness of the second resin film 25 on the first wiring film 21 is almost the same as the thickness of the second resin film 25 on the second wiring film 22. Therefore, the surfaces of the first and second wiring films are exposed almost at the same time as the etching proceeds.

Next, the resist layer 28 is removed. As a result, first and second openings 42a and 42b, which have been patterned so as to give the same diameter as the circular openings 29a and 29b, are formed at the position located upper side of the first wiring film 21 and the second wiring film 22, as Fig. 2(j) shows.

[0024]

As Fig.3 (k) shows, after peeling off the protective film 27 from the surface of the first resin film 17, a resist layer

37 having circular openings 39 at predetermined positions of the first resin film 17 located below the first wiring film 21 is formed. Then a new protective film 30 is applied to the surface of the second resin film 25.

Subsequently, an alkali solution is sprayed onto the surface of the resist layer 37 so as to etch the first resin film 17 exposed at the bottom face of the circular opening 39.

[0025]

Next, the protective film 30 and the resist layer 37 are peeled off. As a result, a third opening 43, which has been patterned so as to give the same diameter as the circular opening 39, is formed in the first resin film 21 located upper side of the first wiring film 21 as shown in Fig. 3(l).

Next, the whole construct is immersed in an electrolytic plating solution and electric current flows therethrough. Thus, a thin metal film grows at the bottom faces of the first, second and third openings 42a, 42b and 43 to form a metal coating 45.

[0026]

In Fig. 3(m), the numerical symbol 10 stands for the flexible wiring board according to the present invention in the state after the formation of the metal coating 45.

In this flexible wiring board 10, the width of the first wiring film 21 is almost the same as the width of the second wiring film 22. However, the thickness of the first wiring film 21 is larger than the thickness of the second wiring film 22

and thus the first wiring film 21 has a larger sectional area because of the larger film thickness.

[0027]

Next, a process for producing a multi-layer flexible wiring board by laminating the flexible wiring board 10 constructed by the above process on other flexible wiring boards will be illustrated by reference to Figs. 4(a) to (c) and 5(d).

The numerical symbol 50_1 in Fig. 4(a) and the numerical symbol 50_2 in Fig. 4(c) stand for monolayer flexible wiring boards to be used in laminating on the flexible wiring board 10 according to the present invention.

[0028]

These flexible wiring boards 50_1 and 50_2 respectively have base film 51, copper wires 53 located on the base film 51, and cover film 55 formed on the copper wires 53. These cover films 55 include thermoplastic resin.

[0029]

On the surfaces of the copper wire 53, metal bumps 59 are formed upright and the heads of these metal bumps 59 protrude respectively on the surfaces of the cover film 55.

[0030]

To construct a multi-layer flexible wiring board by laminating the above-described flexible wiring boards 50_1 and 50_2 on the flexible wiring board 10 according to the present invention, the metal bumps 59 of one of the monolayer flexible

wiring board 50_1 are located toward the first and second openings 42a and 42b in the second resin film 25 of the flexible wiring board 10 according to the present invention, as shown in Fig. 4(a).

[0031]

Next, these metal bumps 59 are brought into contact with the metal coating 45 exposed at the bottom faces of the first and second openings 42a and 42b. Thus, the second resin film 25 of the flexible wiring board 10 and the cover film 55 of the flexible wiring board 50_1 are closely contact with each other.

[0032]

When the whole construct is pressed in this state under heating, the thermoplastic resin in the cover film 55 exerts its adhesiveness due to the heating. A solder plating layer (not shown) is formed on the surface of the metal bumps 59 and the solder plating layer is molten when the whole construct is further heated.

Subsequently, the whole construct is cooled. Then the molten solder plating layer solidifies. Thus, metal bumps 59 and the first and second wiring films 21 and 22 are connected to each other via the solder plating layer which has solidified. At the same time, the flexible wiring boards 10 and 50 are mechanically laminated via the cover film 55.

[0033]

Next, as shown in Fig. 4(c), the metal bumps 59 of the

other monolayer flexible wiring board 50_2 are located toward the third openings 43 of the first resin film 17 of the flexible wiring board 10 according to the present invention.

[0034]

Next, these metal bumps 59 are brought into contact with the metal coating 45 at the bottom face of the third openings 43. Thus, the first resin film 17 is closely contact with the cover film 55. When the whole construct is pressed in this state under heating and then cooled, the metal bumps 59 are connected to the first wiring film 21 via a plating layer (not shown) and, at the same time, the flexible wiring boards 10 and 50_2 are laminated via the cover film 55.

[0035]

The numerical symbol 5 in Fig. 5(d) shows a multi-layer flexible wiring board constructed by laminating monolayer flexible wiring boards 50_1 and 50_2 on respective faces of the flexible wiring board 10 according to the present invention.

In this multi-layer flexible wiring board 5, the copper wires 53 are connected to the first and second wiring films 21 and 22 via the metal bumps 59.

[0036]

Fig. 6 is a diagram showing the relative location of the first wiring film 21 and copper wires 53. Each copper wire 53 has a wide part at the position above the wiring film 21. On those wide part, a metal bumps 59 is formed respectively.

[0037]

Each metal bump 59 is connected to the metal coating 45 on the first wiring film 21 via a plating layer (not shown). Namely, the first wiring film 21 is electrically connected to plural copper wires 53. Fig. 6 shows the situation where three copper wires are connected to one first wiring film 21.

[0038]

Because of having a larger thickness than each copper wire 53, the first wiring film 21 has a larger sectional area. Owing to the larger sectional area, the electrical resistance of the first wiring film 21 is smaller than the electrical resistance of each copper wire 53. In case where an electrical current flows from plural copper wires 53 into the first wiring film 21, the first wiring film 21 can allow the passage of the current with a small voltage drop.

[0039]

Although illustration has been made on a case where the metal coating 45 is exposed at the bottom faces of the first to third openings 42a, 42b and 43 of the flexible wiring board 10, the present invention is not restricted thereto.

The numerical symbols 70 in Fig. 7 and 80 in Fig. 8 respectively show flexible wiring boards of the second and third examples according to the present invention.

[0040]

Similar to the flexible wiring board 10 as shown in Fig.

3(m), these flexible wiring boards 70 and 80 respectively have first resin films 76 and 86, first and second wiring films 71, 72, 81 and 82 formed on the first resin films 76 and 86, and second resin films 77 and 87 formed on the surface of the first and second wiring films 71, 72, 81 and 82. The first wiring films 71 and 81 are separated from the second wiring films 72 and 82 by grooves 73 and 83.

[0041]

Third openings 74 and 88 are formed in the first resin films 76 and 86, while first and second openings 74a, 74b, 84a and 84b are formed in the second resin films 77 and 87 respectively.

[0042]

Among these flexible wiring boards 70 and 80, in the flexible wiring board 70 of the second example as shown in Fig. 7, a metal coating 75 formed at the bottom surface of the first wiring film 71 is exposed at the bottom face of the third opening 74, while metal bumps 79 are provided in the first and second openings 78a and 78b. These metal bumps 79 are formed upright respectively on the surface of first and second wiring films 71 and 72. The head of each metal bump 79 protrudes on the surface of the second resin film 77 and metal coating 75 is formed on the surface of the head.

[0043]

In the flexible wiring board 80 of the third example as shown in Fig. 8, a metal coating 75 formed at the surfaces of

the first and second wiring films 71 and 72 is exposed at the bottom faces of the first and second openings 84a and 84b, while metal bumps 89 are provided in the third opening 88. These metal bumps 89 are formed upright on the bottom surface of the first wiring film 71. The head of each metal bump 89 protrudes on the surface of the first resin film 86 and metal coating 85 is formed on the surface of the head, similar to the case of the flexible wiring board 70 of the second example.

[0044]

The flexible wiring boards 70 and 80 are adhered to the flexible wiring board 10 shown in Fig. 3(m) via the metal bumps 79 and 89. Thus, the flexible wiring board having multilayer structure can be obtained.

[0045]

Although illustration has been made on a case where the metal bump is provided any of first, second and third opening formed on the first and second resin film, the present invention is not restricted thereto and the metal bumps can be provided each of first, second and third opening respectively.

[0046]

Use may be made of a resin film containing a thermoplastic resin as at least one of the first and second resin films of the flexible wiring board according to the present invention. In this case, it is unnecessary to use a thermoplastic resin in the resin films of the other flexible wiring board to be

laminated.

[0047]

Moreover, in the case where none of the resin films used in the flexible wiring boards to be laminated has thermoplasticity, the thermoplastic resin film can be interposed between two flexible wiring boards and then, the two flexible wiring boards are laminated in the manner above-mentioned as Fig. 4(a) and (b). Furthermore, an anisotropic conductive film can be used instead of the thermoplastic resin film.

[0048]

Although illustration has been made on a case where solder plating layers are formed on the heads of the metal bumps 59 of the monolayer flexible wiring boards 50_1 and 50_2 to be used in laminating to the flexible wiring board 10 according to the present invention, the present invention is not restricted thereto.

[0049]

For example, a flexible wiring board having no solder plating layer on the heads of the metal bumps can be laminated to the flexible wiring board 10 according to the present invention by, after mechanically connecting to the flexible wiring board 10 by the steps of Figs. 4(a) and (b), making a resonator of the ultrasonic vibration machine contact with the surface of at lease one flexible wiring board and applying ultrasonic wave so as to connect the metal bumps to the wiring films by applying

ultrasonic wave. Then the flexible wiring films without solder plating layer are surely connected each other.

[0050]

[THE EFFECT ACCORFING TO THE PRESENT INVENTION]

The present invention makes it possible to construct wiring films having a small width and yet showing a small electrical resistance. In flexible wiring boards provided with such wiring films, a high density can be easily achieved.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[Fig. 1] (a) to (e) are diagrams which illustrate the early stage of a process for producing the flexible wiring board of the first example according to the present invention.

[Fig. 2] (f) to (j) are diagrams which illustrate the intermediate stage of a process for producing the flexible wiring board of the first example according to the present invention.

[Fig. 3] (k) to (m) are diagrams which illustrate the latter stage of a process for producing the flexible wiring board of the first example according to the present invention.

[Fig. 4] (a) to (c) are diagrams which illustrate the early stage of a process for producing a multi-layer flexible wiring board by using the flexible wiring board according to the present invention.

[Fig. 5] (d) is a diagram which illustrates the latter stage of a process for producing a multi-layer flexible wiring board by using the flexible wiring board according to the present

invention.

[Fig. 6] is a diagram which shows the relative location of the first and second wiring film of the flexible wiring board of the present invention.

[Fig. 7] is a diagram which illustrates the flexible wiring board of the second example according to the present invention.

[Fig. 8] is a diagram which illustrates the flexible wiring board of the third example according to the present invention.

[Fig. 9] is a diagram which shows a flexible wiring board of the conventional art.

[Description of the items]

10, 70, 80...flexible wiring board

17, 76, 86...first resin film

21, 71, 81...first wiring film

22, 72, 82...second wiring film

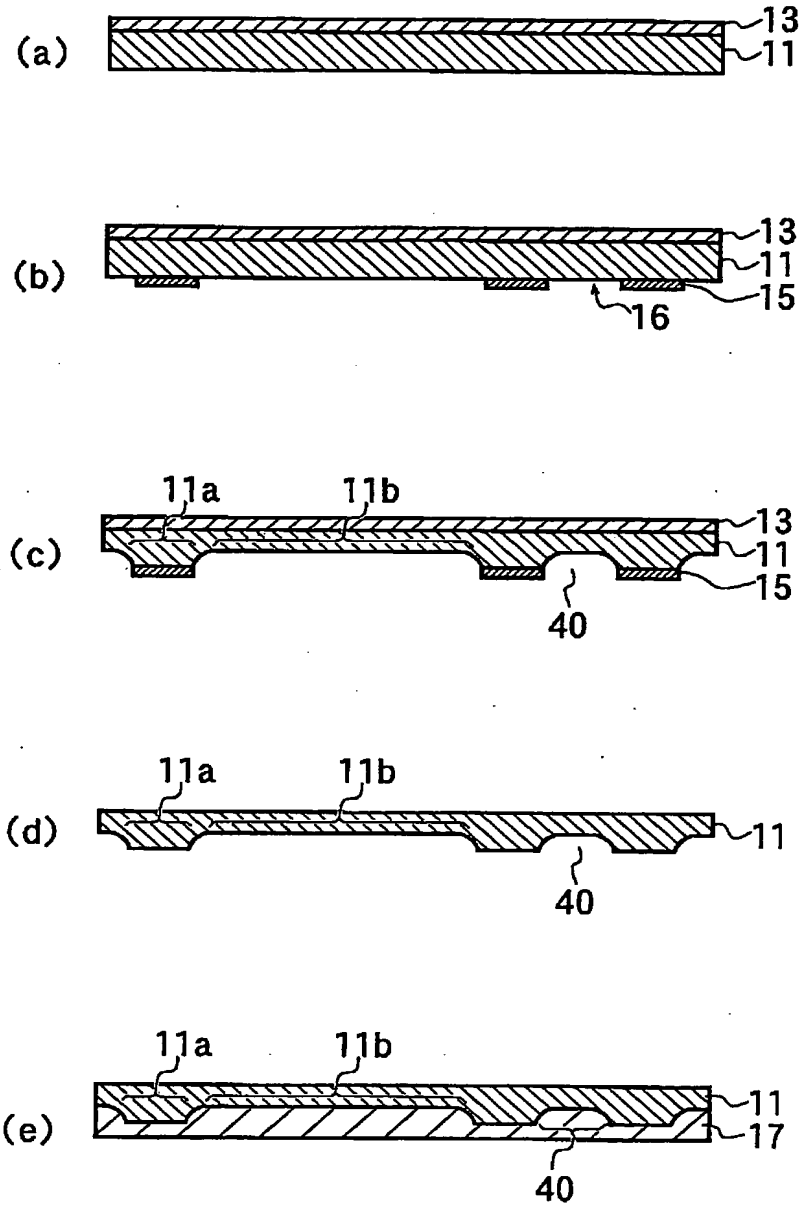
25, 77, 87...second resin film

42a, 74a, 84a...first opening

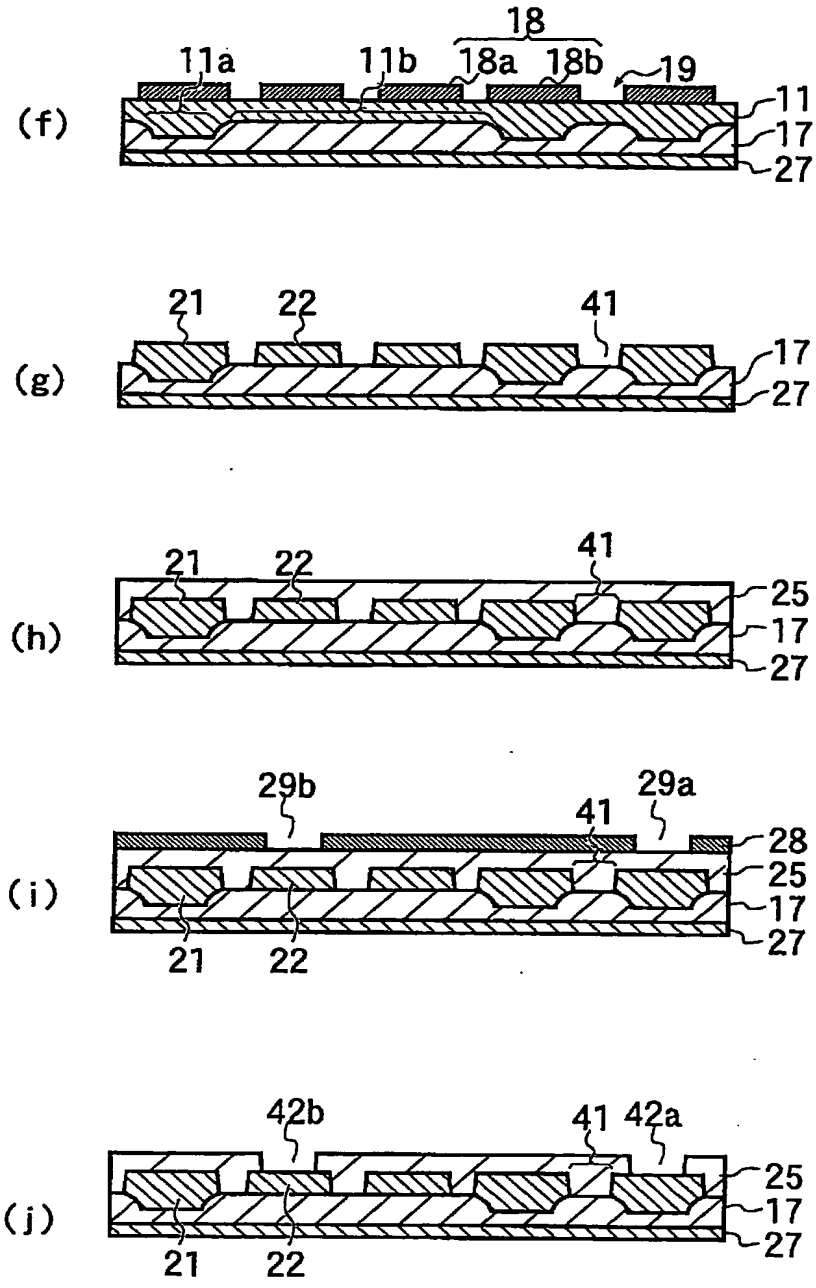
42b, 74b, 84b...second opening

43, 78, 88...third opening

【Fig. 1】



【Fig. 2】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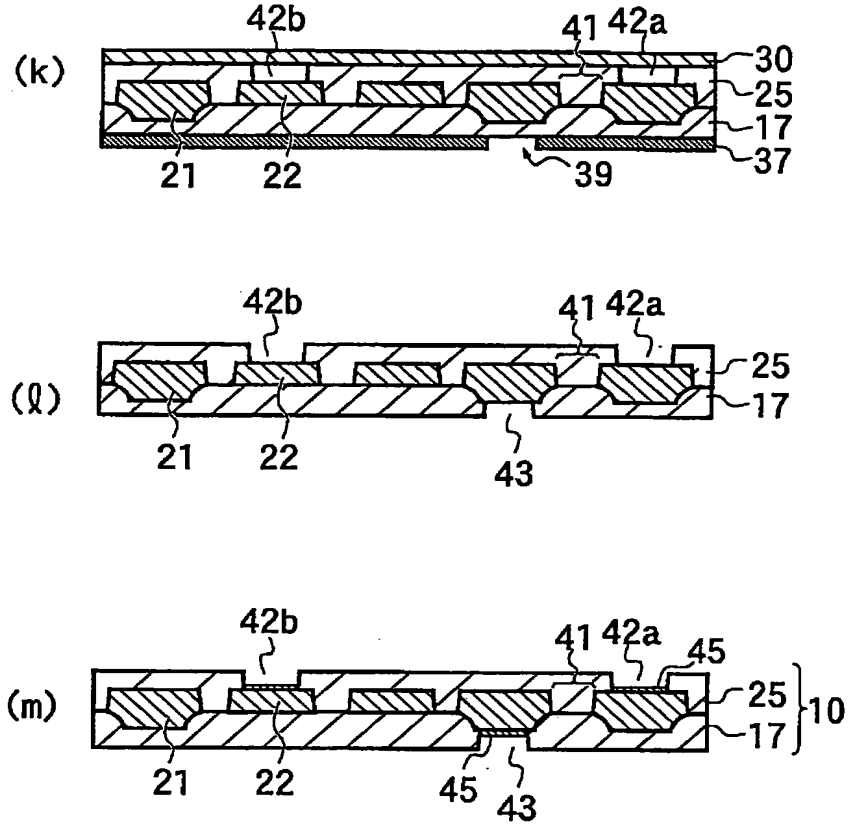
【Fig. 3】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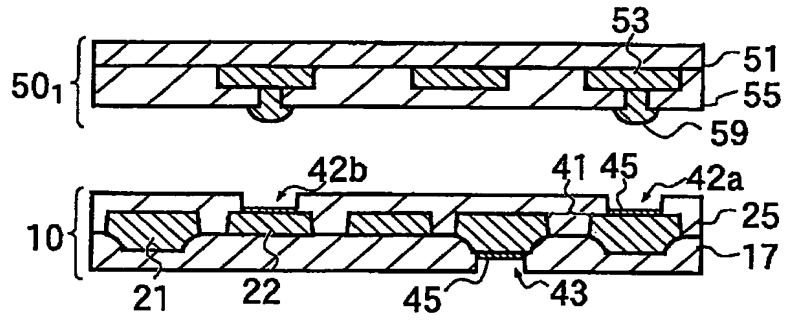
【Fig. 4】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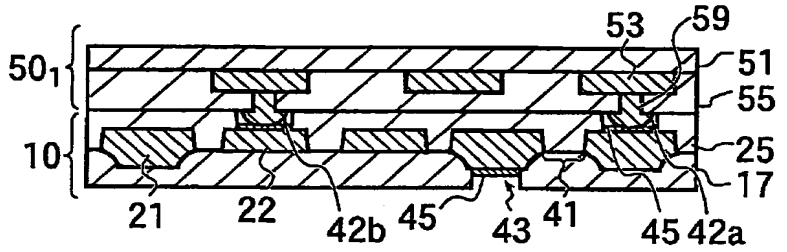
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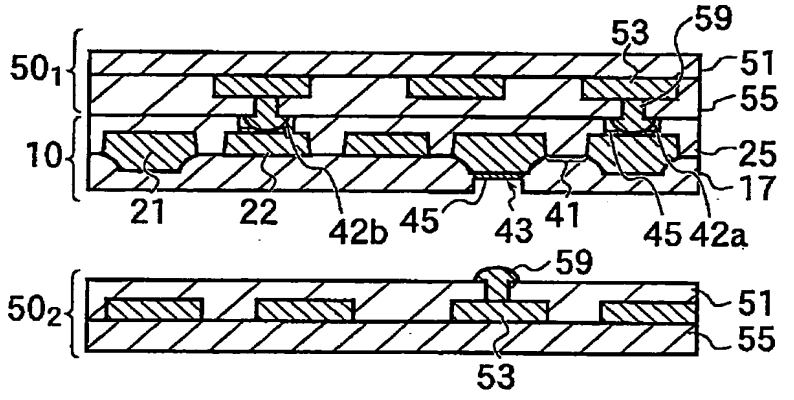
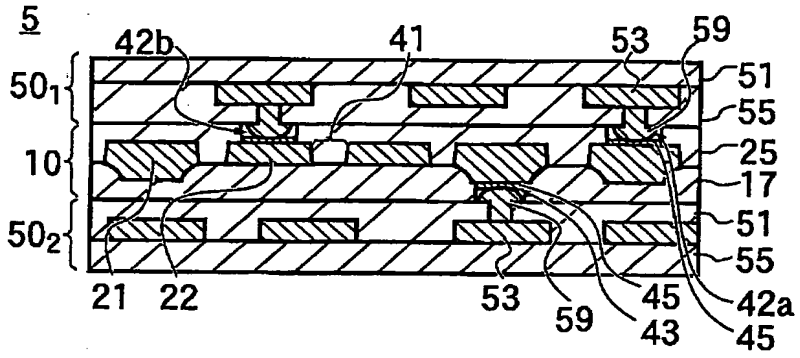
42a

(b)


53
59
50_1
51
55
25
10
17
21
22
42b
45
43
41
45
42a
59
50_2
51
55
53

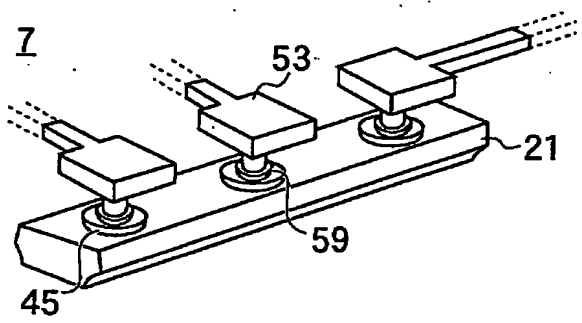
(c)

【Fig. 5】

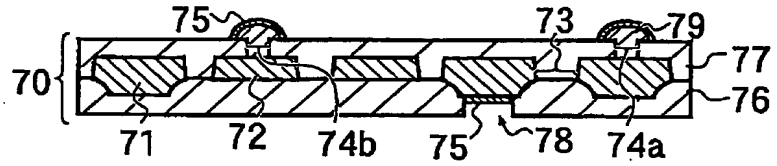

5
42b
41
53
59
50_1
10
50_2
51
55
25
17
51
55
21
22
53
59
45
43
42a
45

(d)

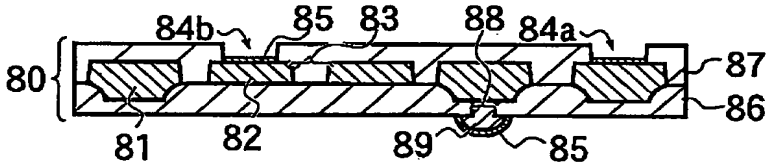
【Fig. 6】


7
53
21
59
45

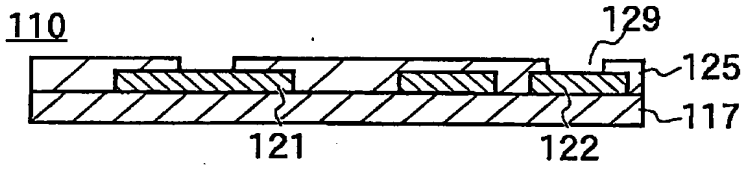
【Fig. 7】



【Fig. 8】



【Fig. 9】



[Document] ABSTRACT

[Abstract]

[Purpose] Wiring films showing a small electrical resistance and yet having a small width is gained.

[Means to solve the problem]The flexible wiring board 10 according to the invention has a first wiring film 21 and a second wiring film 22. Among those wiring films, since the first wiring film 21 has a larger thickness than the second wiring film 22, the sectional area and electrical resistance of the first wiring film 21 can be enlarged because of the larger film thickness even in a case where the first and second wiring films 21 and 22 have almost the same width. Therefore, a high current can flow through the first wiring film 21, though the wiring film has a small width. As a result, a high density of the flexible wiring board 10 can be easily achieved.

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【Amendment 1】

【Amended document】 Specification

【Amended paragraph】 0018

【Amended method】 Correction

【Content of amendment】 1

【Amendment 2】

【Amended document】 Specification

【Amended paragraph】 0041

【Amended method】 Correction

【Content of amendment】 2

【Amendment 1】

【Amended document】 Specification

【Amended paragraph】 0042

【Amended method】 Correction

【Content of amendment】 3

【Amendment 1】

【Amended document】 Specification

【Amended paragraph】 0043

【Amended method】 Correction

【Content of amendment】 4

【NEED OF PROOF】 Yes

[0018]

These openings 19 have a long and narrow shape and the resist layer 18 is divided into plural parts by these openings 19. The numerical symbol 18b stands for the resist layer located on the surface of the thick film part 11a of the metal foil 11, while the numerical symbol 18a stands for the resist layer located on the surface of the thin film part 11b of the metal foil 11.

[0041]

Third openings 78 and 88 are formed in the first resin films 76 and 86, while first and second openings 74a, 74b, 84a and 84b are formed in the second resin films 77 and 87 respectively.

[0042]

Among these flexible wiring boards 70 and 80, in the flexible wiring board 70 of the second example as shown in Fig. 7, a metal coating 75 formed at the bottom surface of the first wiring film 71 is exposed at the bottom face of the third opening 78, while metal bumps 79 are provided in the first and second openings 74a and 74b. These metal bumps 79 are formed upright respectively on the surface of first and second wiring films 71 and 72. The head of each metal bump 79 protrudes on the surface of the second resin film 77 and metal coating 75 is formed on the surface of the head.

[0043]

In the flexible wiring board 80 of the third example as shown in Fig. 8, a metal coating 75 formed at the surfaces of the first and second wiring films 81 and 82 is exposed at the bottom faces of the first and second openings 84a and 84b, while metal bumps 89 are provided in the third opening 88. These metal bumps 89 are formed upright on the bottom surface of the first wiring film 71. The head of each metal bump 89 protrudes on the surface of the first resin film 86 and metal coating 85 is formed on the surface of the head, similar to the case of the flexible wiring board 70 of the second example.

HISTORY OF APPLICANT

REGISTRATION NUMBER [000108410]

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[REASON FOR CORRECTION] NEW REGISTRATION

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